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Impact of a two-way grid refinement at the Strait of Gibraltar on the thermohaline circulation of the Mediterranean Sea

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The Mediterranean Sea is connected to the Atlantic ocean through the Strait of Gibraltar, a narrow and shallow channel, 60 km long and 20 km wide, characterized by a complex system of contractions and sills. These are able to determine, via hydraulic control, the magnitude of the two-way exchange, and also to enhance entrainment and mixing that strongly modify both the inflowing (toward the Mediterranean basin) Atlantic water and the out-flowing Mediterranean water. However, despite the dynamic of the strait is crucial for a correct description of the Mediterranean thermohaline circulation, most of the regional Mediterranean model, developed in the last decades, crudely represent the strait with a rectangular cross section with flat bathymetry. Efforts have been made to take into account mixing, entrainment and hydraulic, in low resolution models, via the development of ad hoc parameterizations, that however did not demonstrate to work properly. At the same time, in recent modeling works it has been demonstrated that numerical models, applied to the strait of Gibraltar region and having sufficient horizontal and vertical resolution, are able to capture all the previously described physical processes. Thus in this work we present an eddy-resolving regional Mediterranean model having a two-way grid-refinement in the region of the strait. The Mediterranean model has been implemented using the finite volume MITgcm at 1/8°x1/8° of horizontal resolution with 42 vertical levels, while in the strait region the grid-refinement increases the resolution up to 1/24°. In order to evidence the influence of the strait dynamics on the internal Mediterranean thermohaline circulation, two experiments, reproducing the actual climate conditions, were performed with and without grid-refinement. Comparing the two experiments some differences

have been found; in particular the experiment with the grid-refinement has shown a better representation of the formation of deep water in the area of the Gulf of Lion as well as an increased strength of the Mediterranean thermohaline circulation cell.